Northwestern Virginia Railroad, Grafton Bridge
(B & O Railroad, Grafton Bridge)
Spanning Tygart's Valley River
Grafton
Taylor County
West Virginia

HAER No. WV-11

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
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HISTORIC AMERICAN ENGINEERING RECORD

Northwestern Virginia Railroad, Grafton Bridge
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Location:	Spanning Tygart's Valley River Grafton, Taylor County, West Virginia
Dates of Construction:	1854, 1890, c. 1910
Builder/Designer:	Benjamin Latrobe, Chief Engineer Albert Fink, Resident Engineer
Present Owner:	The Chessie System
Significance:	Typical of the transition from timber to metal bridge construction, the original Fink spans were probably the longest tri-composite trusses then (1854) in existence, and most likely represented the maximum possible length for the design. One original pier remains, partly supporting a deck plate girder bridge.
Historian:	Dennis Zembala

In the 1850's, Grafton became the most important junction on the Baltimore and Ohio Railroad. The town itself was a creation of the railroad, built to accomodate the shop buildings* of the B&O and of its subsidiary, the Northwestern Virginia Railroad. The original shop complex of the B&O was located two miles down the line at Fetterman, where the railroad intersected the old Northwestern Turnpike.[1] But, by 1851, the B&O had already determined that the first link in its direct route to Cincinnati and St. Louis would diverge from the Wheeling route at the junction of the Tygart's Valley River and Three Forks Creek. Construction began on the Parkersburg Branch (Northwestern Virginia Railroad) in 1852, and by 1853, the community at the junction had a population of 154. The Wheeling line had been completed the previous Christmas and the B&O was free to turn its attention to the new route. President Swann resigned from the B&O to become president of the Northwestern Virginia; Benjamin Latrobe became its chief engineer and Albert Fink was installed as resident engineer on the line. The Mt. Clare foundry began turning out castings and bars for the new road to the West. During 1853, work was begun on the stone machine shop and foundry building, and a temporary, frame half-roundhouse was erected. By December, the stone abutments and river pier had been completed and were ready to receive the iron superstructure of the bridge.[2]

By the following year, the machine shop was completely outfitted and ready to begin "working up the materials of the bridge superstructure." In 1856, the road department shops and a pumping station were erected on the bank of the Tygart's Valley River, just north of the bridge, convenient for the use of both lines. Work was also begun on two frame buildings at the foot of John Street to serve as a temporary station. In 1856-57, the permanent passenger and freight station was built in the triangle between the river and the junction of the two companies' tracks.[4] This complex included a hotel and was architecturally more elaborate than the rest. It was described as "a grand structure, composed of the Gothic and Corinthian style of architecture and in the point of extent of dimensions and beauty of its appearance will compare favorably with many hotels in larger cities."[5] Its monumentality was a fitting symbol of the importance of the town to operations on the western portion of the line.

Fink's bridge across the Tygart's Valley River in Grafton was a clue to the regard in which the western route was held by the B&O management. It was a first-class bridge, built to last and to carry heavy loads. The masonry pier and abutments were finished in December 1853. They were of a durable sandstone taken from the same nearby quarry which

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* (See introduction to Northwestern Virginia Railroad Machine Shop, Grafton, West Virginia)

furnished stone for the entire section from Grafton to Parkersburg.[7**] By late 1854, the superstructure was in place and ready to receive the track. The original Grafton bridge -- a tricomposite structure of timber, cast-iron and wrought iron, was almost identical to the Cheat River Bridge at Rowlesburg. (See: Baltimore and Ohio Railroad: Rowlesburg Bridge, WV-13.) Its two spans were both Fink trusses, each approximately 200' in length. (WV-11-1) The top and bottom chords were white pine from "The Glades" in Allegheny County, Maryland.[9] The cast-iron compression members and the wrought iron tension members were produced at the Grafton machine shop and foundry.[10]

Like the bridge over the Cheat River, the one at Grafton was typical of the transition from timber to metal in bridge construction. At that time, knowledge of the strength of metals was very limited. It was generally known that cast-iron was more suitable for compression members and wrought iron for tension members. Beyond this, little was known of the relative strengths of each or of the causes of the great variations in the quality of foundry products. In addition, no accurate formula had as yet been found to determine the size and action of forces exerted by moving loads. Fink's scientific education at the Polytechnic School of Darmstadt provided him with a mathematical reference for his designs and forced him to think of each member in terms of its function.[11] Between 1850 and 1853, Fink's work on the bridges and viaducts of the Cumberland-Wheeling extension formed the basis for the nascent discipline of scientific structural engineering. Few records remain to document this development and we may only guess at the sequence of its evolution. Yet, fortunately, in the case of the Grafton bridge, a few old photographs give us some insight into the place of this structure in that process.

A cursory glance at old photographs of the Cheat River Bridge (1852) and the Tygart's Valley River Bridge (1854) might lead one to conclude that the two were identical in every respect (see WV-11-4 and WV-13-3). Yet, from an engineering standpoint, there was one very important difference. While the earlier version at Rowlesburg had two spans of 180 and 132 feet, those at Grafton measured approximately 200 feet,[12] making them probably the longest tricomposite trusses in existence. Indeed, they were only 5 feet shorter than Fink's all-metal version on the Monongahela at Fairmont (1852). There is good reason to believe that the Tygart's Valley River Bridge represents the ultimate development of the tricomposite truss. Except for the 200 foot span at West Fork (23 miles west of Grafton), these were the longest spans on the Parkersburg Branch. When the time came to build the long-span bridges over the Ohio, the B&O abandoned the use of timber chords.[13] As railroad loads increased, this type of construction became outmoded. Sometime between 1884 and 1890, the company found it necessary to build intermediate piers for added support.[14] (WV-11-5) Two piers were added to each span

** The western abutment was located on what was originally an island cut off from the west bank by a narrow channel. At the time of construction, this channel was filled in and its flow diverted into the main stream.[8]

at the points where the secondary tie rods joined the lower chord. This measure transformed a structure of 2 spans of 200 feet length into one of 6 spans - 4 of 50' length and 2 of 100'. The addition of 2 piers to each spans shows that by this time increasing loads had resulted in serious overstressing of the structure. A single additional pier at the midpoint of each span would have been a simpler, less-expensive measure. On the other hand, the use of two additional piers seems to indicate that the B&O engineers were able to calculate, more or less exactly, the increased loads. The emerging discipline of stress analysis made the seriousness of the problem quite clear. Fink's original bridge had been an important contribution toward making bridge engineering an exact science. By the 1880's, such techniques enabled engineers to determine the insufficiency of the earlier structure. As a result, the destruction of Fink's original spans came because of a derailment and not through the failure of later engineers to calculate and compensate for increased loads (see photo of 1890 disaster. HAER WV-11-6).

FOOTNOTES

1. Charles Brinkman, "The History of Taylor County," Grafton Sentinel, Vol. 37, no. 39 (1939), p. 4.
2. Northwestern Virginia Railroad, Third Annual Report (Baltimore, 1854), p. 16. Hereafter cited as N.W.V.R. Report (year).
3. Ibid, p.17.
4. Brinkman, Vol. 37, no. 50 (May 27, 1939), p. 4.
5. Edward Hungerford, The Story of the Baltimore and Ohio Railroad, 1817-1927 (Baltimore, 1928), p. 296.
6. N.W.V.R. Report (1854), p.16.
7. Brinkman, Vol. 37, No. 50, p.14.
8. Brinkman, Vol. 37, no. 45, p.4.
9. N.W.V.R. Report (1854), p.17.
10. N.W.V.R. Report (1855), p. 22.
11. See HAER Report on Tray Run Viaduct for information on Fink's background and his approach to engineering design.
12. N.W.V.R. Report (1854), p.16.
13. Theodore Cooper, "American Railroad Bridges," Transactions A.S.C.E., Vo. XXI, (1889).
14. See photocopy of 1884 view. HAER WV-11-6.